23-070815 REV 01 RS

SOLGEN POWER

November 16, 2023

Subject: Proposed Solar Panel Installation
Scott McCracken Residence, 2225 SE 157th Ave, Portland, OR

To Whom it May Concern,

Our engineering department has reviewed information, gathered by our field crews, related to the proposed solar panel installation at the above-referenced address. The purpose of our review was to determine the structural adequacy of the existing roof. Based on our review and analysis of the available information, and in accordance with governing building codes, it is our professional opinion that the existing structure is permitted to remain unaltered for the proposed solar installation.

Design Parameter Summary

Governing Building Code: 2022 Oregon Structural Specialty Code (2022 OSSC)
Risk Category: II
Design Wind Speed: 98 mph (per ASCE 7-16)
Ground Snow Load: 20 psf
Roof Snow Load: 20 psf (city/county requirement)

Roof Information

Roof Structure: 2x6 Rafters @ 24" O.C.
Roofing Material: Asphalt Shingles (1 layer)
Roof Slope: 21 degrees

Roof Connection Details

RT Minis into 2x rafters or truss top chords at 48" O.C.; install per design drawings and manufacturer specs
Locations per design drawings
Note: Required embedment length excludes the tapered tip of the screw, and embedment into sheathing.

Analysis

The proposed installation - including weight of panels, racking, and mounts - will be approximately 2.91 psf. The attached calculations show that the existing roof structure is adequate to support the proposed installation. Therefore, the structure need not be altered for gravity loading.

The proposed installation will be 6" max. above the roof surface (flush mounted) and parallel to the roof surface. Therefore, any increase in wind loading on the building structure from the solar panel installation is expected to be negligible. Wind is the governing lateral load case. Because the increase in lateral loading is not increased by more than 10%, per section 3408.6.3 of the OSSC (IEBC 806.3)

Wind uplift on the panels has been calculated in accordance with the relevant provisions of ASCE 7-16. This loading has been used to verify the adequacy of the connection specified above. Connection locations should be in accordance with design drawings.

Conclusion

The roof structure need not be altered for either gravity or lateral loading. Therefore, the existing structure is permitted to remain unaltered. Connections to the roof must be made per the "Roof Connection Details" section above. Copies of all relevant calculations are enclosed.

Limitations and Disclaimers

The opinion expressed in this letter is made in reliance on the following assumptions: the existing structure is in good condition; the existing structure is free from defects in design or workmanship; and the existing structure was code-compliant at the time of its design and construction. These assumptions have not been independently verified, and we have relied on representations made by the property owner and his or her agents with respect to the foregoing. The undersigned has not inspected the structure for patent or latent defects.

Electrical engineering is beyond the scope of this analysis. Solar panels must be installed per manufacturer specifications. Structural design and analysis of the adequacy of solar panels, racks, mounts, rails, and other components is performed by each component's respective manufacturer and the undersigned makes no statement of opinion regarding such components. This letter and the opinions expressed herein are rendered solely for the benefit of the permitting authority (city or county building department), and may not be utilized or relied on by any other party.

If you have any questions or concerns, please contact our office at (855)-709-1181, or email Austen.Morfin@solgenpower.com.

Sincerely,
Trevor A. Jones, P.E.

11/16/2023

SOLGEN POWER

Note: Beam is assumed fully restrained by attachment to sheathing
Note: This calculation is not applicable for trusses
Note: Design per NDS and ASCE 7

Detailed Beam Calculation for Roof 1, 2 & 3

The purpose of this calculation is to justify the additional solar load by demonstating beam capacity is adequate for the increased demand.

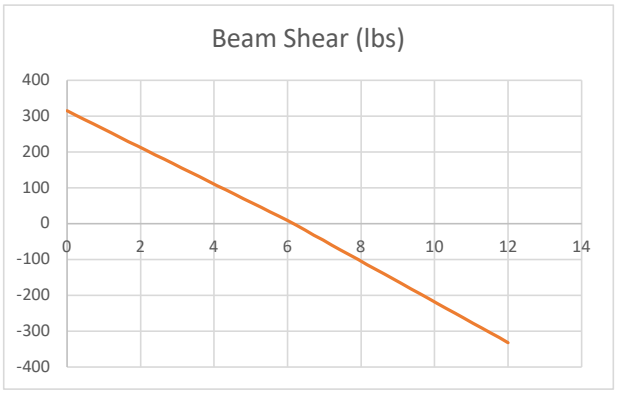
Existing Dead Load			Beam Span, L	12	ft
Asphalt Shingles	3	psf	Beam Member Size	2x6	
1/2" Plywood	1	psf	Wood Species	DFL #2 (Assumed)	
Framing	1	psf	Beam Spacing	2	ft
M,E, & Misc	0.5	psf	Retrofit member (where applies)	--	
Total Existing Dead Load	5.5	psf	**Sawn Lumber Properties**		
Snow Load			F_b	900	psi
Ground Snow Load, P_g	20	psf	F_v	180	psi
Exposure Factor, C_e	0.9		Load Duration Factor, C_D	1.15	
Thermal Factor, C_t	1.1		Size Factor, C_F	1.3	
Importance Factor, I_s	1.0		Repetitive Member Factor, C_r	1.15	
Flat Roof Snow Load	20	psf	F'_b	1547	psi
Slope	21	degrees	F'_v	207	psi
Unobstructed Slippery Surfac	No		E	1600000	psi
Slope Factor, Cs	1.00		(Note: $C_M = C_t = C_L = C_{fu} = C_i = 1.0$)		
Sloped Roof Snow Load	**20.0**	psf			
Live Load	**20.0**	psf	**Member Properties**		
Governing Load Combination			***Main member:***		
DL + SL	25.5	psf	Width, b	1.5	in
Calculation Values			Depth, d	5.5	in
Linear load, w	51	plf	Area, A	8.3	in^2
Reaction, R_1	306	lbs	Moment of Inertia, I	20.8	in^4
Reaction, R_2	306	lbs	Section Modulus, S	7.6	in^3
			Retrofit member (where applies):		
Solar Panel Dead Load			Width, b	--	in
Distributed Load	2.91	psf	Depth, d	--	in
Linear load, w	5.82	plf	Area, A	--	in^2
Distance to surcharge, a	6	ft	Moment of Inertia, I	--	in^4
Surcharge length, b	6	ft	Section Modulus, S	--	in^3
Distance from surcharge, c	0	ft			
Reaction, R_1	8.73	lbs	**Deflection Criteria**		
Reaction, R_2	26.19	lbs	Under Total Load:	L / 120	

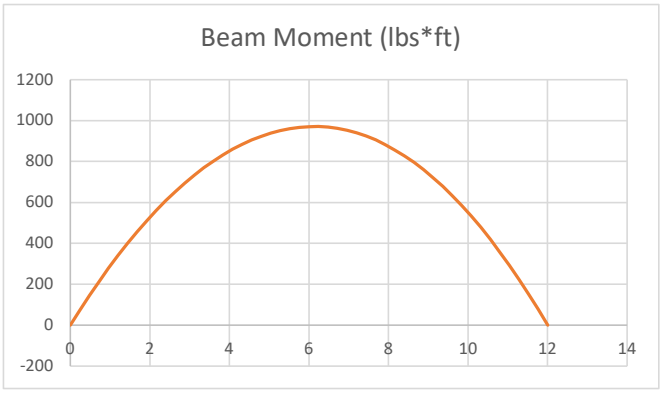
Total Demand			**Total Capacity**		
Shear	**498.3**	lbs	Shear	**1707.8**	lbs
Moment	**970.8**	lb*ft	Moment	**975.1**	lb*ft
Deflection	**0.76**	in	Deflection	**1.2**	in

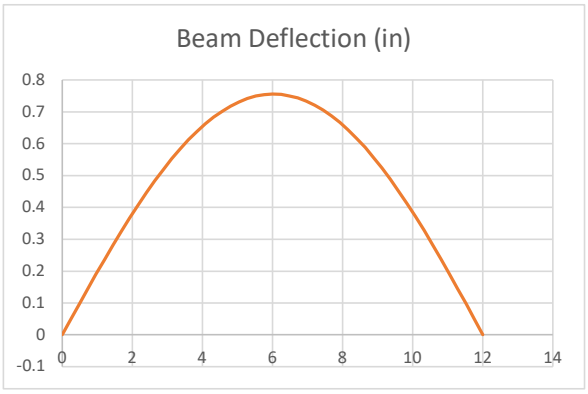
Result:

Since calculated capacities are equal to or greater than calculated demands, the beam capacity is adequate for the increased demand from solar panels, and the existing roof structure is permitted to remain unaltered.

The following page shows the shear, moment, and deflection values across the length of the beam.


Beam Shear (lbs)
400
300
200
100
0
-100
-200
-300
-400
0
2
4
6
8
10
12
14


Beam Moment (lbs*ft)
1200
1000
800
600
400
200
0
-200
0
2
4
6
8
10
12
14

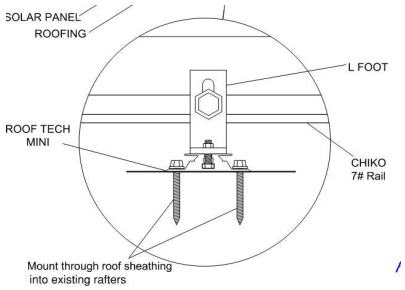

Beam Deflection (in)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
0
2
4
6
8
10
12
14

RT Mini Connection Calculation

This calculation justifies the connection of the solar panels to existing roof members, by showing the connection capacity is equal to or greater than the uplift force demands. Minimum embedment is 1.5 inches,

Connection Demand

Spacing perpendicular to rail	32.5	in (1/2 panel length)
Roof Angle	21	degrees
Roof Type	Gable	
Wind Speed	98	mph
Topographic Factor, K_{zt}	1	
Directionality Factor, K_d	0.85	
Elevation Factor, K_e	0.99	
Velocity Pressure, q_z	16.0	psf



	Zone 1	Zone 2r	Zone 3	
Spacing parallel to rail	48	48	48	in (max)
Effective Wind Area on each connection	10.8	10.8	10.8	ft^2
GC_p (max)	1.90	1.97	1.97	
Exposed Panels? (γ_E = 1.5)	No	No	No	
Pressure Equalization Factor, γ_a	0.79	0.79	0.79	
Uplift Force	23.9	24.8	24.8	psf
Max. Uplift Force / Connection (1.0 WL)	258.4	268.9	268.9	lbs
ASD Factored (0.6 WL)	155.0	161.3	161.3	lbs
Solar Dead Load (0.6 DL)	18.9	18.9	18.9	lbs
Max. Uplift Force (0.6 WL - 0.6 DL)	**136.1**	**142.4**	**142.4**	**lbs**

Connection Capacity

Connection Type	RT Mini (Rafter Mount)		
Total Allowable Capacity	**447.0**	**lbs**	(per manufacturer)

Compare ASD Factored Demand to Capacity

Demand	142.4	lbs
Capacity	447.0	lbs
Result	**Capacity exceeds demands. Therefore, connection passes.**	